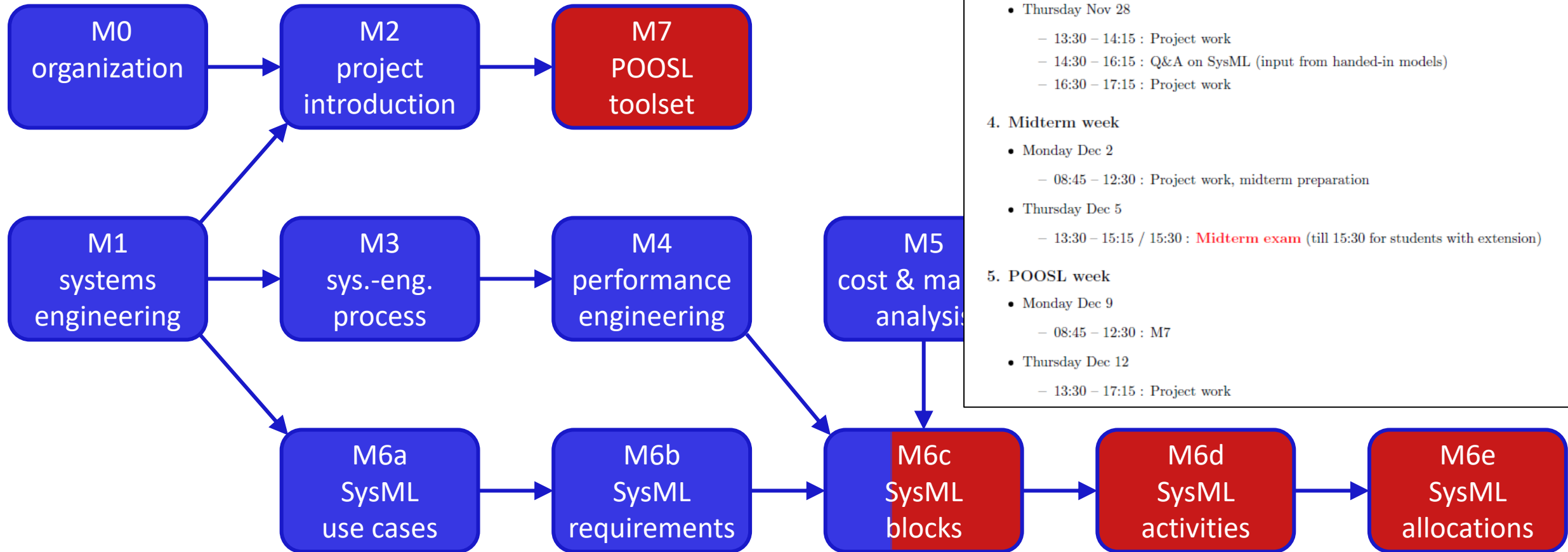


# 5XIC0 Electronic-Systems Engineering

**Twan Basten, Martijn Hendriks**

Electrical Engineering

# modules



M6c - SysML blocks

## 3. SysML week

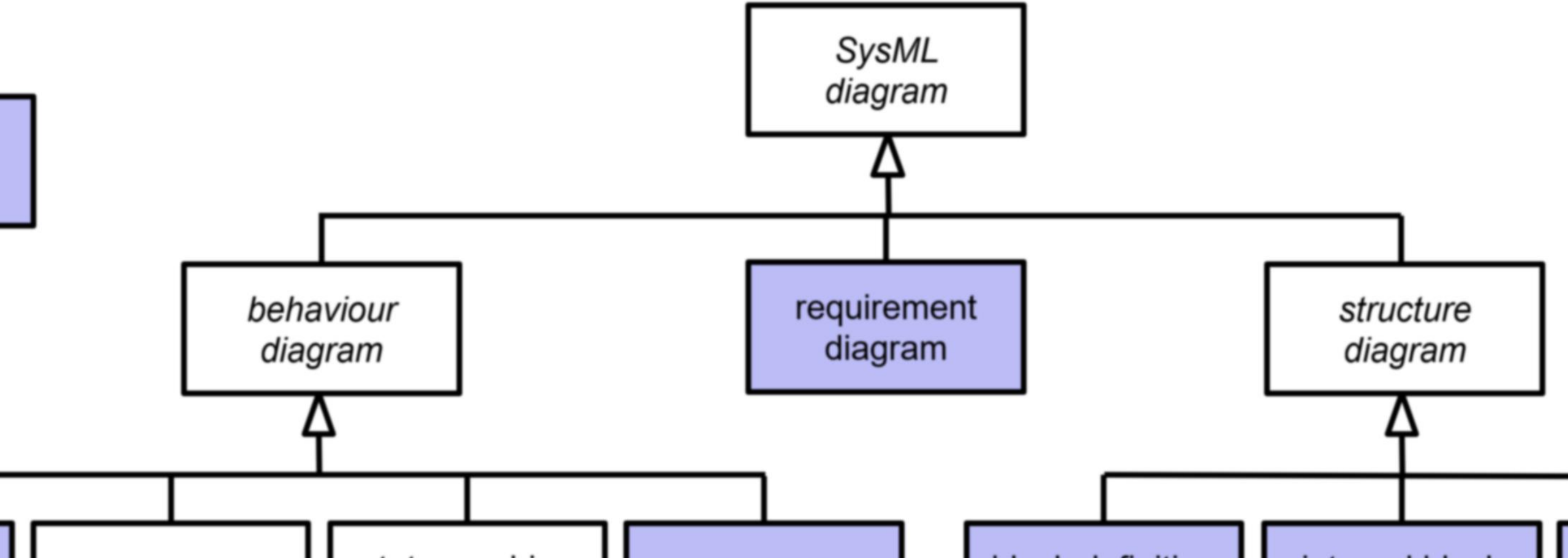
- Monday Nov 25
  - 08:45 – 09:30 : Project work
  - 09:45 – 10:30 : M6d
  - 10:45 – 11:30 : M6e
  - 11:45 – 12:30 : Project work
  - CANVAS DEADLINE 23:59 – Papyrus model for feedback**
- Thursday Nov 28
  - 13:30 – 14:15 : Project work
  - 14:30 – 16:15 : Q&A on SysML (input from handed-in models)
  - 16:30 – 17:15 : Project work

## 4. Midterm week

- Monday Dec 2
  - 08:45 – 12:30 : Project work, midterm preparation
- Thursday Dec 5
  - 13:30 – 15:15 / 15:30 : **Midterm exam** (till 15:30 for students with extension)

## 5. POOSL week

- Monday Dec 9
  - 08:45 – 12:30 : M7
- Thursday Dec 12
  - 13:30 – 17:15 : Project work



## M6c – SysML blocks part 2

5XIC0 Electronic-Systems Engineering

Martijn Hendriks

Slides in part based on a slide set of Kees Goossens and Dip Goswami

parametric  
diagram

# in this lecture

## SysML blocks

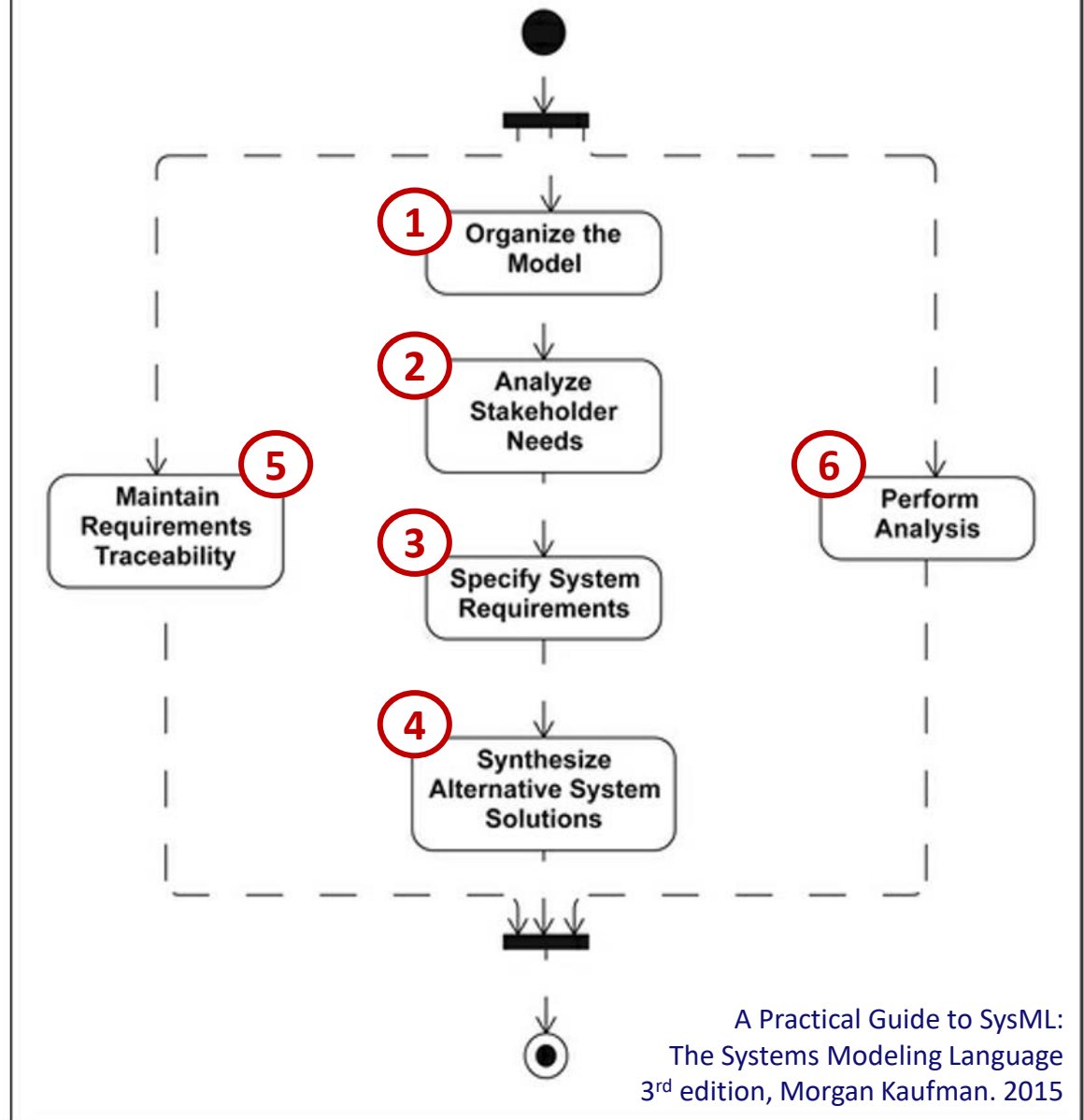
- modeling block internals
- modeling interfaces and flows

## diagrams

- internal block diagrams

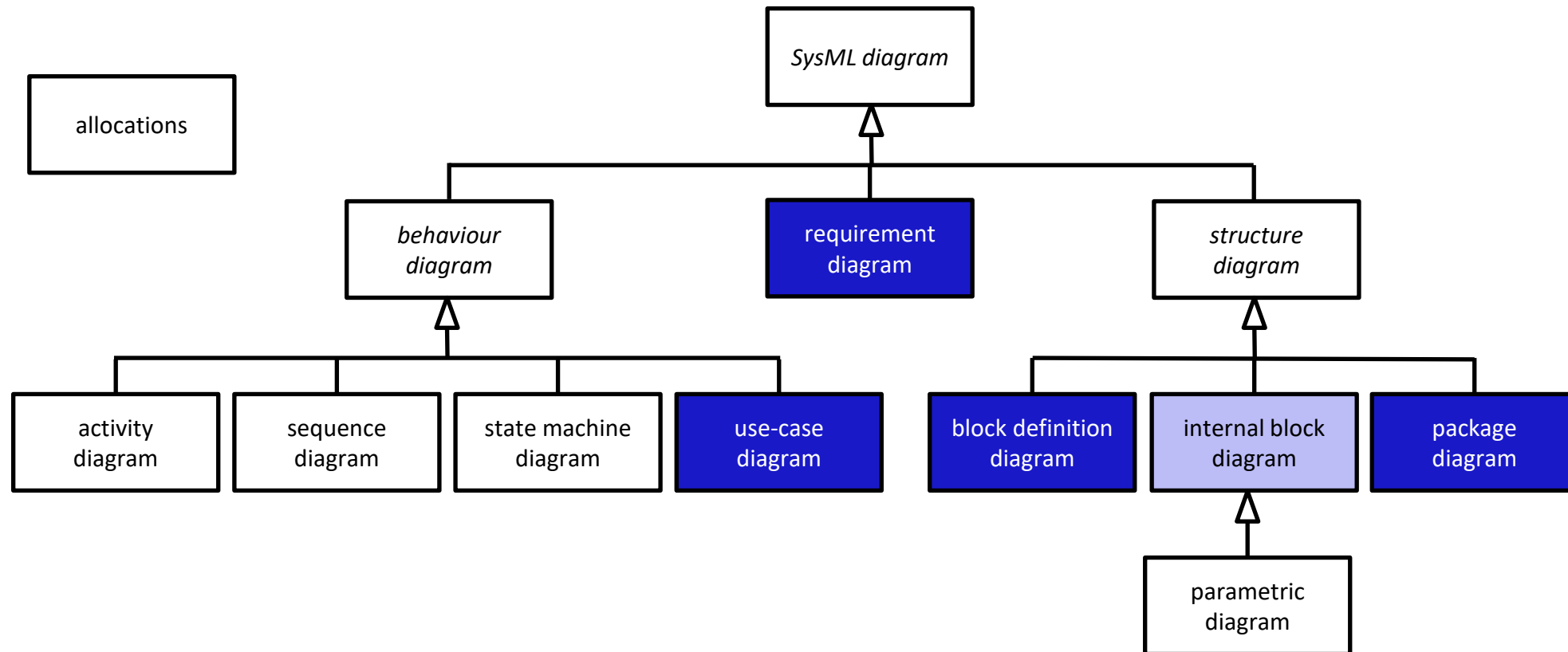
# a simplified<sup>2</sup> MBSE method

1. SysML package diagram
2. stakeholders  
SysML UC diagrams, UC descriptions  
measures of effectiveness (moes)
3. SysML requirement diagrams
4. create multiple alternatives
  - **SysML BDDs – system decomposition**
  - **SysML IBDs – interconnections**
  - SysML Activity diagrams – UC refinements
  - SysML Allocations – activities to blocks
5. requirements tracking
  - SysML Allocation – reqs to blocks/activities
6.
  - SysML PAR diagrams – covering all moes
  - POOSL models – makespan
  - analytical model – profit
  - verification

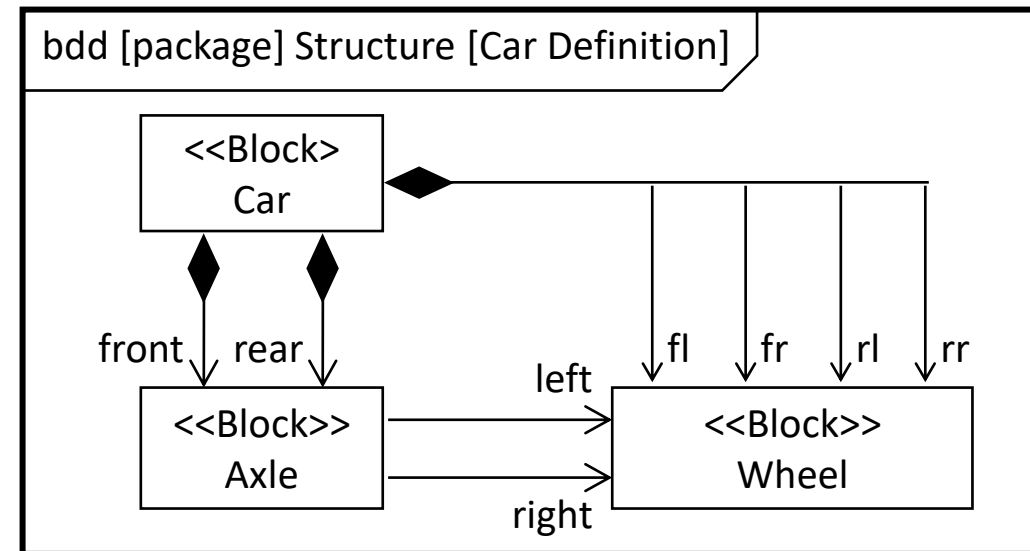
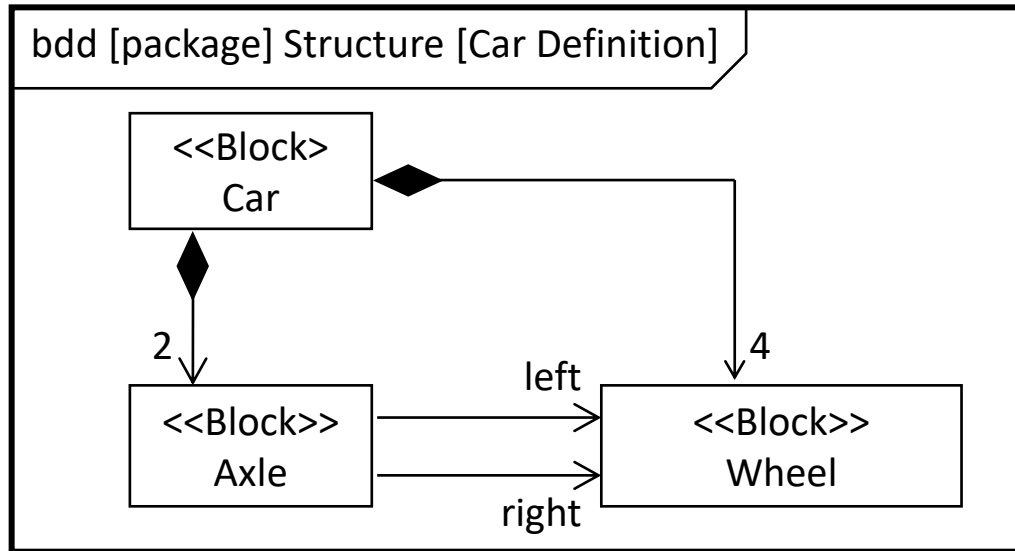


# SysML – diagram overview

diagrams are **views** on the model  
(i.e., on a subset of **model elements**)



# SysML – internal block diagrams – modeling internals



Wheels all have a different role

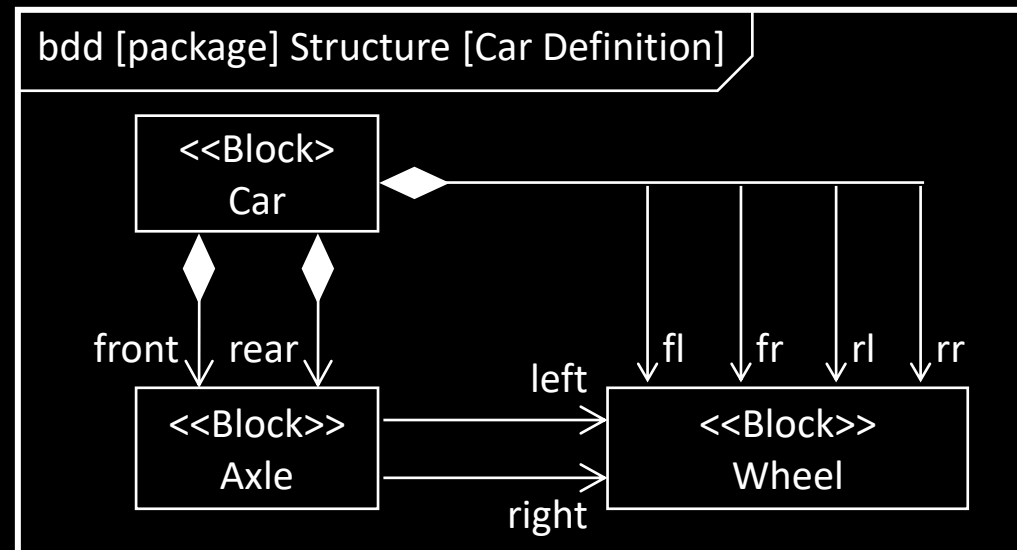
Do this if you want to be able to refer to the wheels individually in your ibd

# think – pair – share

what are default multiplicities on composite associations

how many parts does a car have

how are they connected





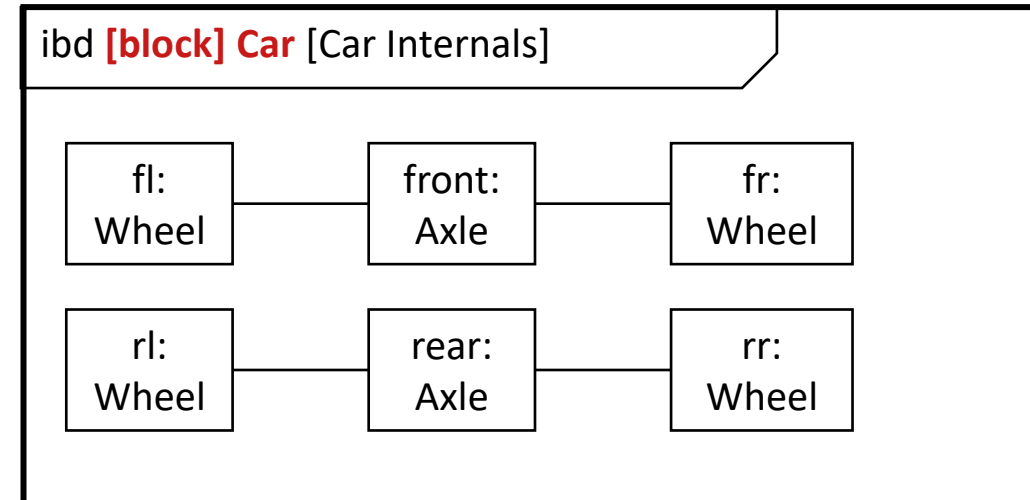
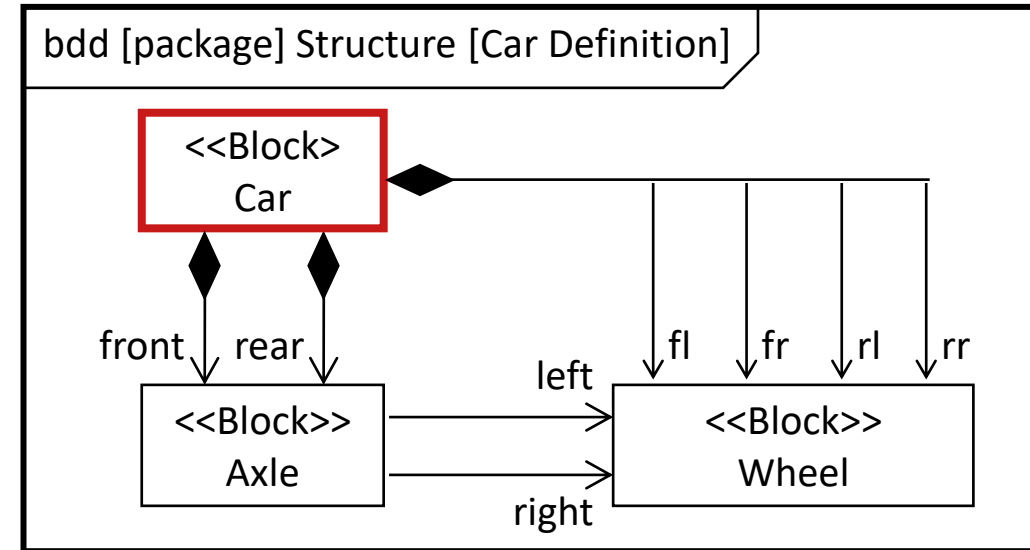
# SysML – internal block diagram (ibd)

## internal block diagram

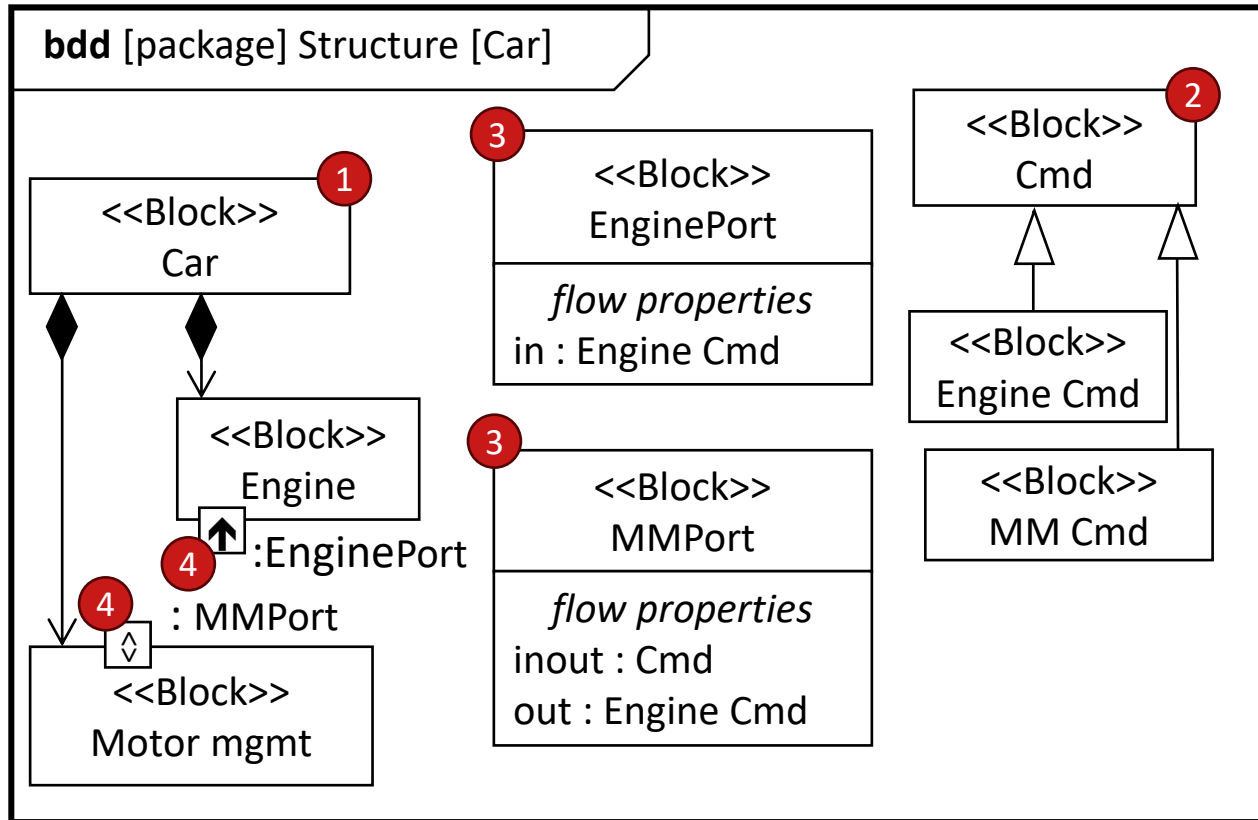
- context is always a single **block**
- **parts** or **references** are shown inside the block and can be **connected**
  - **connector** models that there is a connection/communication between two features

## used for

- modelling **internal block structure**
  - parts are shown as solid blocks (can be nested)
  - references are shown by dashed blocks
  - can be connected
- detailed modelling of **interfaces** and **flow** (e.g., fuel, electricity, data, pieces, ...) with **ports**

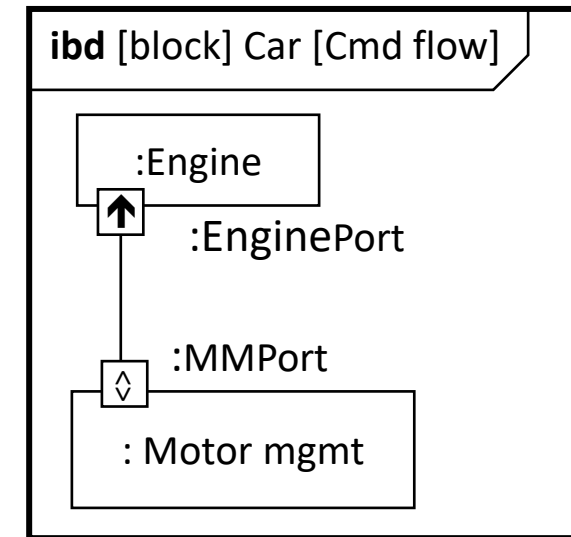
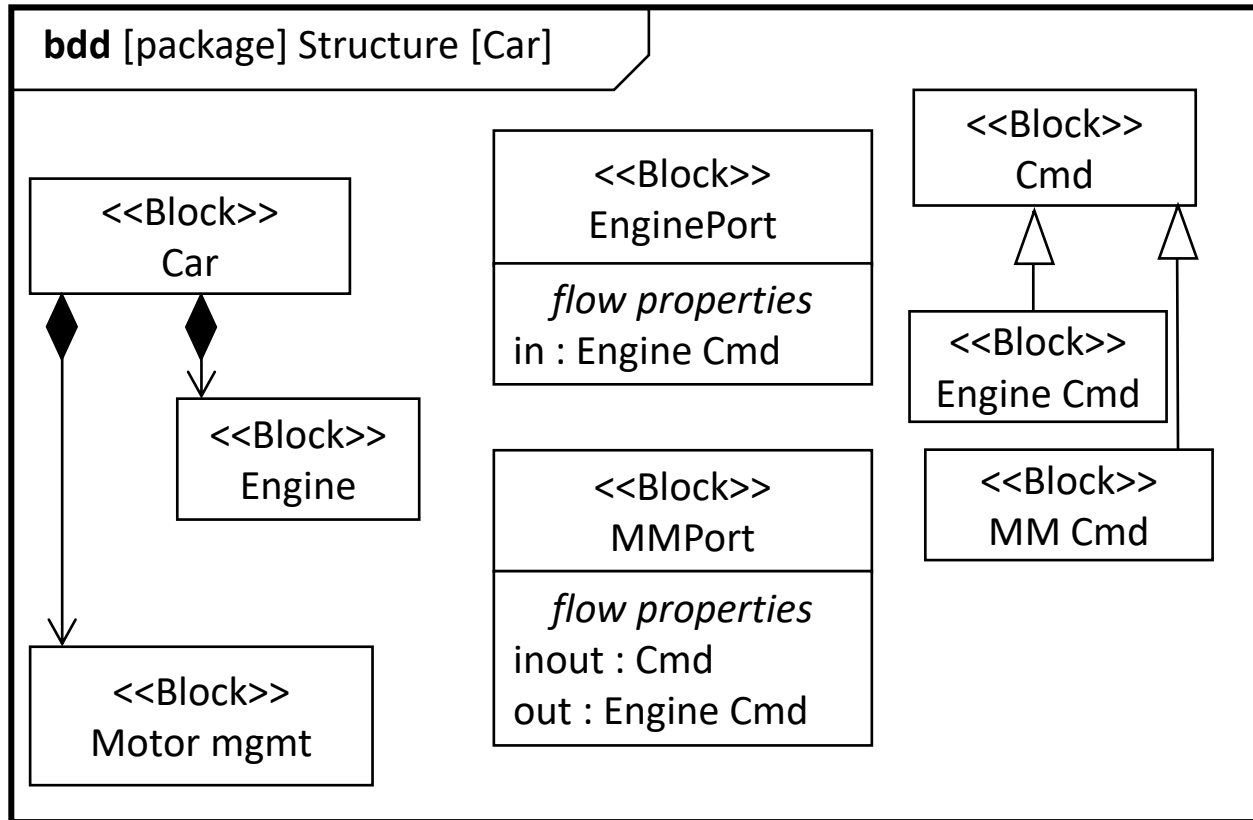


# SysML – modeling interfaces and flows – diagrams



1. block and its parts
2. what flows between the parts
3. types of the interfaces (ports)
4. add ports to the blocks
  - arrow indicates the direction of flow properties of the port's type

# SysML – modeling interfaces and flows – diagrams



# SysML – modeling interfaces and flows – model elements

## block features

- **full ports:** access point on a boundary of a block (or on boundary of a part/reference typed by that block)
  - **typed** by another block
  - which may have **flow properties:** a special property that specifies *what* flows; has a direction (in, out, inout)

## connectors: between full ports and parts on a bdd or ibd

- full ports can be bound to other full ports or parts (constraint on matching flow properties: type & direction)

# SysML – internal block diagrams, ports and flows

Recommended reading:

- 7.3.1 (parts about IBDs)
- 7.4 (not 7.4.3 about Item flows)
- 7.6, 7.6.1, 7.6.3 (not proxy ports)

Also look at the SysML 1.6 specification (Annex D gives many examples)

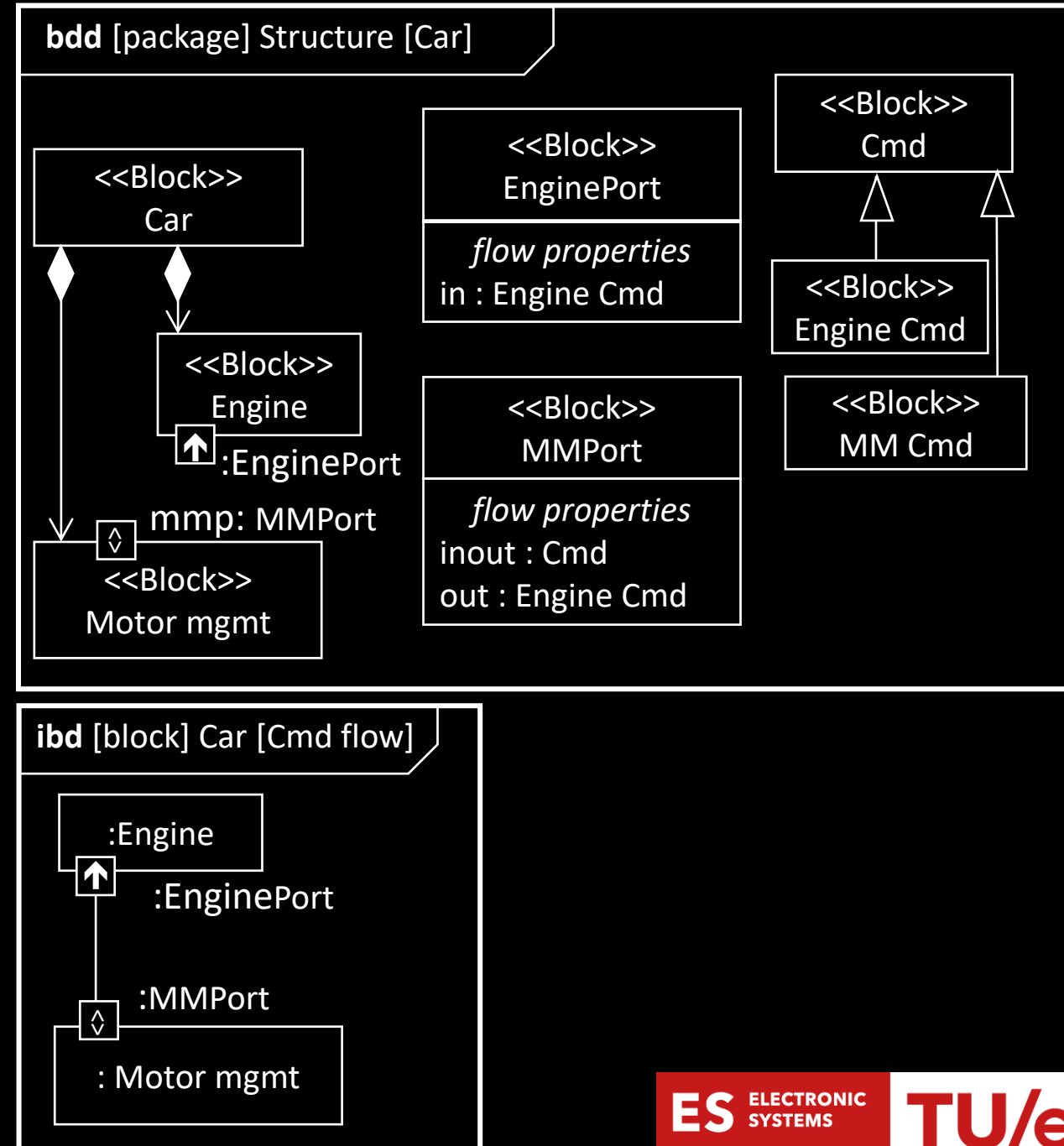
- <https://www.omg.org/spec/SysML/1.6/PDF>

# think – pair – share

- a car has 4 wheels and 2 axles
- an axle has 3 bolts on each end
- a wheel consists of a rim (with 3 bolt holes) and a tire
- model this with a BDD and IBD

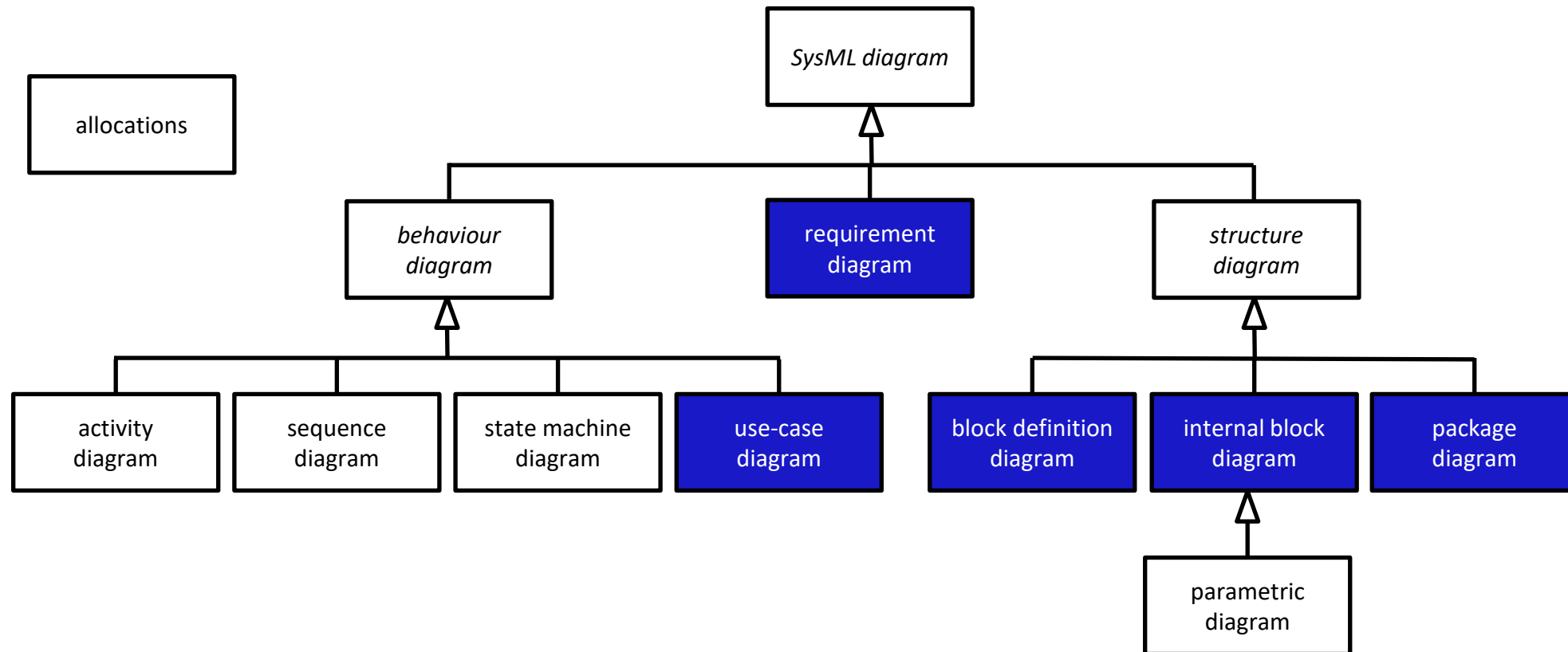
*hint: use ports to model the bolts and bolt holes*

SysML blocks - IBDs

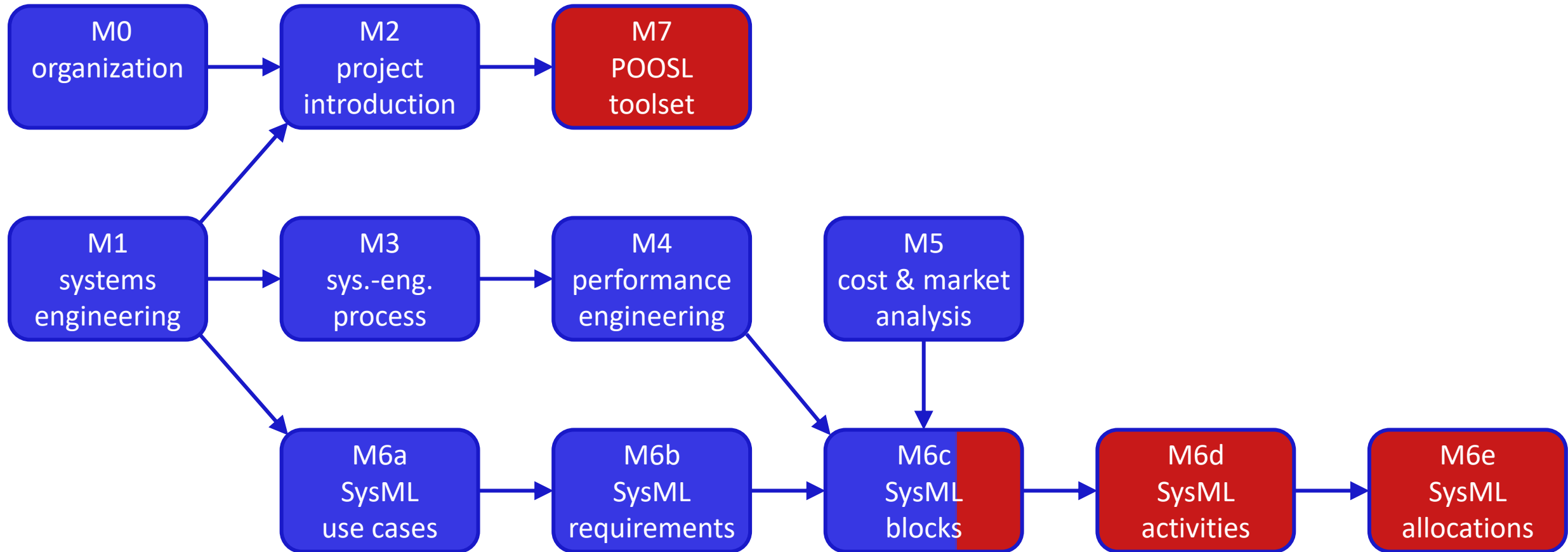


# SysML – diagram overview

diagrams are **views** on the model  
(i.e., on a subset of **model elements**)



# modules



M6c - SysML blocks



# to remember

ibd to model structure, connection and flow inside a single block

nesting of blocks on an ibd is allowed; but might challenge encapsulation principles

refinement of communication/flow modeling between parts of blocks:

- *what flows*: modeled by blocks (e.g., fluid, current, commands, ...)
- *type of the interface*: modeled by a block
  - may have *flow properties* that specify what flows through the interface
- *end points*: modeled by ports (structural feature of blocks)
  - *ports are typed by* a block, i.e., the block that specifies the interface (see above)